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UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

SUSCEPTIBILITY OF THE MEMPHIS WATER SUPPLY
TO CONTAMINATION FROM THE PESTICIDE WASTE
DISPOSAL SITE IN NORTHEASTERN HARDEMAN COUNTY,
TENNESSEE

U.S. GEOLOGICAL SURVEY

Open-File Report 79-750

Prepared in cooperation with the
Tennessee Department of Public Health
Division of Water Quality Control

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By D. R. Rima

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Nashville, Tennessee

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Susceptibility of the Memphis water supply
to contamination from the pesticide waste
disposal site in northeastern Hardeman County,
Tennessee

by D.R. Rima

Abstract

Public concern has been expressed over the possibility that leachates from a pesticide waste-disposal site in northeastern Hardeman County, Tennessee, might eventually reach the Memphis area and endanger the City's water supply.

An examination of the possible pathways and means of transport of these contaminants reveals that, although a pathway exists, the probability of pollutants migrating from the disposal site in Hardeman County to the Memphis area in detectable concentrations is unlikely.

Introduction

A great deal of concern has been expressed over the possibility that the Memphis water supply might eventually become contaminated by the migration of leachates from the pesticide waste-disposal site which is located about 70 miles east of the City in northeastern Hardeman County, Tenn. (fig. 1). This concern is an outgrowth of the knowledge that several private wells in the immediate vicinity of the disposal site have become contaminated by a variety of organic chemicals leached from the buried wastes by circulating ground water. The possibility of the contaminants ever reaching Memphis is discussed in this report in terms of the possible pathways and potential transport mechanisms.



Figure 1.--Location of the pesticide waste disposal site in Northeastern Hardeman County. Geologically, the site lies within the outcrop area of the "500-foot" sand.

Possible Pathways

There are basically two possible pathways that the contaminants might follow. One is through the subsurface and the other is overland. A subsurface pathway exists because the "500-foot" sand from which Memphis withdraws its water supply is geologically and hydrologically continuous from the Memphis area to northeastern Hardeman County. Thus, contaminants could migrate through the interconnected interstices in this sand body provided a favorable gradient could be established and maintained for a sufficient period of time to allow the contaminants entrained in the ground-water flow system to be transported from the disposal site to Memphis.

An overland pathway exists in that leachates from the disposal site have entered the water-table aquifer and are moving in a northerly direction toward Clover Creek, a right-bank tributary to the Hatchie River (Sprinkle, 1978). Hence, with time the entrained contaminants could be discharged into Clover Creek, then to the Hatchie River and subsequently the Mississippi River. The Mississippi River passes directly over the cone of depression caused by pumping in the Memphis area; therefore, water could potentially enter the aquifer from the river due to induced leakage.

Potential Transport Mechanisms

In order for contaminants to migrate through the subsurface towards Memphis there must be a favorable ground-water gradient. Existing ground-water gradients, however, do not favor movement of the contaminants toward Memphis (Geraghty and Miller, 1979). In order to establish the necessary ground-water gradient, the cone of depression caused by withdrawals of ground water in the Memphis area would have to be expanded from its present limits in the vicinity of the Shelby-Fayette County line across an interval of about 50 miles of outcrop of the aquifer to northeastern Hardeman County (fig. 1). Within this interval are two large rivers, the Loosahatchie and Hatchie, both of which would act as line sources of recharge to retard any further development or spread of the cone of depression. With the current configuration of Memphis as the primary pumping center, the establishment of the necessary ground-water gradient for the length of time that would be required for particles of contaminated ground water to travel the 50 miles from the disposal site through the aquifer to the Shelby County line is highly unlikely.

Regarding the overland route, the stream system constitutes the potential mechanism of transport. Although there is no doubt about the course followed by surface drainage from northeastern Hardeman County to Memphis, there are a number of factors that lessen the probability of contaminants being transported to Memphis and adversely affecting the Memphis water supply. They are:

- (1) The contaminants are primarily organic chemicals that have a far greater affinity for clayey or carbonaceous materials than for water (Faust, 1972). Thus, the contaminants upon entering Clover Creek can be expected to adhere to particles of sediment which are

characteristically abundant in the surface streams of western Tennessee. In essence, the particles of sediment in the stream will remove the organic contaminants from the water phase and incorporate them in the solid phase. This condition will prevail unless or until the sediment in the stream becomes saturated with respect to the contaminants. In view of the abundance of sediment in the stream, it seems likely that by the time a particle of contaminant from the disposal site has reappeared in Clover Creek and traveled a few miles downstream it will be bonded to a particle of sediment after which its destiny will be determined by the ultimate fate of the sediment and not that of the water. Hence, the probability of a particle of contaminant from the disposal site reaching the waterfront at Memphis and then reentering the subsurface as leakage from the Mississippi River into the Memphis aquifer is virtually nil.

(2) The length of time that would be required for a particle of contaminant to be transported by the overland route from northeastern Hardeman County to the Memphis area is very long. Current knowledge indicates that it probably takes at least a decade for contaminated ground water to move from beneath the disposal site to Clover Creek (Sprinkle, 1978). The time of travel of water particles from there, the point of possible contaminant entry into Clover Creek, to the river front at Memphis would be on the order of a week to a month or more (S.P. Sauer, U.S. Geological Survey, oral commun., 1979). However, if the movement of the contaminant is tied to that of the sediment this part of the journey might take several years. Even so, after reaching the river front at Memphis the contaminants would need to be dislodged from their bonds with the sediment in order to reenter the subsurface as leakage into the Memphis aquifer. This part of the trip (from the river to the subjacent aquifer) might take several decades. Again, the contaminants would be exposed to more clayey and carbonaceous material in the confining bed that separates the river from the Memphis aquifer. Depending on the point of entry, it could take another several decades for the contaminated ground water to reach a point where it could be withdrawn in a water supply. The trip from the disposal site in the northeastern Hardeman County to the aquifer beneath Memphis could take from a century to a millenium if indeed it were to happen at all.

(3) The third factor is the quantity of contaminant material that might be transported. The amounts known to be entrained in the ground water in northeastern Hardeman County are perhaps an order of magnitude or so above the present limits of detection (Terry Cothran, Tennessee Division of Water Quality Control, oral commun., 1979). Upon reaching Clover Creek this amount can be expected to be diluted approximately to the present level of detection. By the time these contaminants reach

the Hatchie River the dilution factor will have reached such proportions as to render the task of identification futile. There are still two more major points of dilution to be considered; the junction with the Mississippi River and finally the Memphis aquifer itself. Thus, if the most up-to-date monitoring system were employed using the most sophisticated and elaborate sampling techniques it is doubtful whether contaminants from the disposal site in northeastern Hardeman County could be detected at the mouth of Clover Creek, much less in the Hatchie River.

Conclusion

On the basis of present knowledge and conditions, it is unlikely that contaminants will migrate from the disposal site in northeastern Hardeman County to endanger the aquifer serving the Memphis metropolitan area. Of course, major unforeseen changes in ground-water use could change this picture. To consider all ground-water withdrawal possibilities would require development of a digital model of the flow system as well as a solute transport model.

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